POTENTIAL CONTRIBUTION OF SMALL PELAGIC FISH TO FOOD SECURITY WITHIN THE ASIA-PACIFIC REGION

APEC OCEAN AND FISHERIES WORKING GROUP

Asia-Pacific Economic Cooperation

February 2013

POTENTIAL CONTRIBUTION OF SMALL PELAGIC FISH TO FOOD SECURITY WITHIN THE ASIA-PACIFIC REGION

FINAL REPORT

OCEAN AND FISHERIES WORKING GROUP

FEBRUARY 2013

APEC Project FWG 01/2010A

Produced by

Daniela Lainez del Pozo
CL Clemente X Nº131, Lima 33, Peru
Tel: +51 1 231 5106
Mobile: +51 9906 31893
Email: dlainez@gmail.com

For

Asia Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace Singapore 119616
Tel: +65 68919 600
Fax: +65 68919 690
Email: info@apec.org
Website: www.apec.org

APEC#213-OF-01.1

Executive Summary

The project 'Potential Contribution of Small Pelagic Fish to Food Security' originated from the need to study the potential supply and use of small pelagic fish to tackle food security. As such, the project took Indonesia and the Philippines, top producers of small pelagic fish in the region, as case study economies with Peru as the leading economy of the project.

Capture statistics were collected and analysed for the case study economies to assess their potential supply of small pelagic fish. Consumption data was also collected and analysed to Asses the potential contribution of small pelagics supplies to food security.

Production of small pelagic fish in Indonesia and the RP shows an increasing trend of production in time series data, but due to the large human populations that these economies bear, their production is not enough to satisfy their own demand for fish. Moreover, even though fish statistics production appears to be on the positive side, the increasing production is a direct reflection of increased effort but not of healthy stocks. A majority of the fishing grounds and some stocks of small pelagics have a history of over exploitation well above of their maximum sustainable yields, locating these stocks at imminent risk of collapse if continued to be overfished. Sustainable management measures are recommended to reduce the pressure on small pelagics resources. It is thus recommended that the excess demand of fish be satisfied by produce from other economies of the region with healthier and more sustainable fish stocks. Peru could be an option given that the surplus production of the Peruvian small pelagics stocks could be paired to the dominant preference and demand of the Indonesian and Philippine populations for small pelagic fish species for human consumption.

The limitations and opportunities of using value-added products to tackle food security were assessed, with the finding that the greatest limitation is not technological but of distribution as economies of the Asia-Pacific region are of archipelagic nature with dissected territories that make distribution of fisheries resources to isolated and land-locked areas very difficult. Physical access is thus the greatest problem, followed by proper handling and good post-harvest practices. The greatest opportunity for the use of value-added products of small pelagics is the imprinted cultural taste and preference for small pelagic fish, and the portability that value-added produce could achieve to allow for proper distribution to the most remote areas.

In order to share Peru's experience in research and monitoring of small pelagics stocks, and to share knowledge on the production of value-added products from small pelagics monitoring, a meeting took place in Lima in October 2012 with the visit of representatives of the two case study economies. During the meeting future areas for the transfer of technology and knowledge were identified.

Table of Contents

List of Acronyms

APEC – Asia-Pacific Economic Cooperation

ASFIS – Aquatic Sciences and Fisheries Information

BFAR – Bureau of Fisheries and Aquatic Resources (The Philippines)

FAO – Food and Agriculture Organization of the United Nations

GRT – Gross registered tonnage

INA – Indonesia

IUU – Illegal, unreported, and unregulated fishing

MCS – Monitoring, control and surveillance

MMAF – Ministry of Marine Affairs and Fisheries (Indonesia)

MT – Metric ton

NFRDI – National Fisheries Research and Development Institute (The Philippines)

RCFMC – Research Center for Fisheries Management and Conservation (Indonesia)

RP – The Republic of the Philippines

SPF – Small pelagic fish

VMS – vessel monitoring system

WFP – World Food Programme

Acknowledgements

I would like to give special thanks to Mr Jose Allemant (Project Overseer of APEC) and Ms Kalen Su (ex-Lead Shepherd of the Ocean and Fisheries Working Group) from the *Vice-Ministry of Fisheries* of the *Ministry of Production* of Peru for proposing the project, facilitating contact with stakeholders, hosting and organising the meeting in Lima, and offering expert advice for the development of the project.

Special thanks are also due to Mr Noel Barut and Ms Eunice Gasmin, from the *National Fisheries Research and Development Institute* of the *Bureau of fisheries and Aquatic Resources* of the Philippines, and Mr Duto Nugroho and Mr Suwarso from the *Research Center for Fisheries Management and Conservation* of the *Ministry of Marine Affairs and Fisheries* of Indonesia, for providing their valuable knowledge and their guidance and support throughout the duration of the project.

Ms Jessica Muñoz and Ms Sitti Hamdiyah from the Philippines and Indonesia respectively, were also helpful in providing first contacts and guidance for the implementation of the project.

Mr Noel Barut, Ms Eunice Gasmin, Mr Suwarso, Mr Andhika Prima Prasetyo and Mr Diyan were key to the fieldwork component of the project and excellent companions, providing all the technical and logistical support required.

The network of enumerators of the NFRDI in the landing areas visited was extremely helpful and key for attaining the successful number of surveys conducted in the Philippines.

In general, staff from the *National Fisheries Research and Development Institute* of the Philippines and staff from the *Research Center for Fisheries Management and Conservation* of Indonesia were exceptionally supportive while conducting fieldwork in the two case study economies.

Interviewees are also accredited and thanked for their time and willingness to help in the project, providing their own perspectives on the subject of study.

The Asia-Pacific Economic Cooperation commissioned this study.

1. Introduction

Robert Malthus first raised food security as a global issue in the 18th century in his keystone *Essay on the Principle of Population*. More than two hundred years have passed since, and even though there has been an overall improvement in food security worldwide, still 12.5% of the global population remains chronically undernourished (FAO, WFP and IFAD, 2012), and under the prospects of a continuously growing population, the concern of insufficient food resources holds true more than ever.

1.1 Food security in Asia-Pacific

1.1.1 Definition of food security

The Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD), and the World Food Programme (WFP) define food security as:

> '*A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*' (FAO, IFAD and WFP, 2012, p. 57)

APEC recognises this commonly accepted definition and adds that for the APEC region, food security is based on a conceptual model of four dimensions that involve: (1) food availability, (2) physical access to food, (3) economic access to food, and (4) utilisation of food (APEC, 2012a).

1.1.2 Food security and fisheries for the APEC

Food security has an important position in the world's development agenda, including the Asia Pacific Economic Cooperation (APEC) forum. APEC had its first meeting of Ministers Responsible for Food Security in 2010, in Niigata, Japan. The establishment of this meeting responded to the call made in 2007 by the peaking prices of food that reminded world leaders of the current instability of food supplies and the need to carry out conscious work to achieve long-term food security.

At this first meeting the APEC Action Plan on Food Security was endorsed with the activities that each economy proposed to implement to contribute to strengthen food security in the region in the following five years. Peru agreed to study the potential supply and use of small pelagic fish products for human consumption to help attain the first shared goal of the Action Plan related to the sustainable development of the agricultural sector, and expanding the food supply capacity (APEC, 2012b). This initiative was also to converge with the Paracas Action

Agenda that resulted from the 2010 APEC Oceans-Related Ministerial Meeting, which highlighted the support towards initiatives that incorporate sustainably managed small pelagic fish for human consumption (APEC, 2010).

In 2012, the APEC Ministers Responsible for Food Security met again in Kazan, Russia, to reaffirm their commitment to the continuity of the efforts started towards the cause in 2010. Amongst the strategies to strengthen food security in the region, supporting the sustainable management of marine ecosystems, fisheries and aquaculture was emphasised recognising the key role that fisheries and aquaculture play in the livelihoods and economic well being of many APEC economies, thus encouraging efforts to include ocean related issues in supporting regional economic integration in line with the Leaders` Growth Strategy (APEC, 2012a).

It is in this context that the Peruvian Economy proposed and undertook the project 'Potential contribution of small pelagic fish to food security within the Asia-Pacific region' with Indonesia and the Philippines as strategic partners, and Chile, Chinese Taipei, and the United States of America as co-sponsor Economies. The study was commissioned by the APEC Ocean and Fisheries Working Group (OFWG) to complement APEC's work in the area. The project implementation lasted eleven months from March 31st 2012, until February 15th 2013, and took place in Indonesia, Peru and the Philippines.

1.1.3 State of food insecurity in Asia-Pacific

Asia-Pacific is the region that leads the progress in the reduction of undernourishment and food insecurity, and seems to be currently on track to achieve its hunger target for the Millennium Development Goals, both in number and proportion of the undernourished population (FAO, WFP and IFAP, 2012).

The share of the world's undernourished people has declined fastest in South East Asia from 13.4% to 7.5% between 1990-92 and 2010-12, followed by East Asia from 26.1% to 19.2%, while in South Asia the share increased from 32.7% to 35% in this same period (FAO, WFP and IFAP, 2012).

Within Asia, South East Asia is the sub region that experiences the fastest progress tackling undernourishment, in 1990-92, 29.6% of its population was undernourished and only ten years later this figure was reduced to 10.9%. Improvement was also observed independently in the economies that conform South East Asia, including Indonesia and the Philippines. In Indonesia the decrease on the prevalence on undernourishment is remarkable, from 19.9% to 8.6%; in the Philippines the decrease is also evident, but represents the slowest among other economies of South East Asia, it was reduced from 24.2% to 17% for the same time period (FAO, WFP and IFAP, 2012).

This overall improvement of food security in Asia can be accounted to the rapid economic growth of the region, which has allowed the population access to better balanced diets that

contain notably higher shares of animal-source foods, fruits and vegetables, and a lesser proportion of cereals, roots and tubers. Meat and fish consumption has tripled in developing economies, showing a strongest growth in East and South East Asia. Taking Indonesia as an example, the proportion of animal-source foods in people's diets more than doubled from 1961-63 to 2007-9 (FAO, WFP and IFAP, 2012).

Nonetheless, the number of undernourished people is still highest in the Asian region; with 563 millions of undernourished people, Asia is home of 64.9% of the total of undernourished people in the world (FAO, WFP and IFAP, 2012).

1.2 Relevance of fisheries to food security in Asia-Pacific

1.2.1 Contribution of fish and fisheries to food security

Fish is highly nutritious and of great value to fish consuming communities like Asia and the Pacific. Especially in rural and coastal populations of the region, fish is the most accessible and affordable source of animal protein. Fish based condiments are central and irreplaceable ingredients of daily diets and traditional recipes all across Asia and the Pacific. Marine fish in particular, provide high quality protein that is easily digested and contains a wide variety of essential vitamins, minerals, fatty acids and amino acids difficult to obtain in rice-based diets like the ones predominant in the region. (Lymer *et al*., 2008).

The APEC region supplies more than two-thirds of the fish caught in the world, of which Asia alone consumes two-thirds and the whole APEC region consumes 70%. Fish contribute largely to the protein supply in Asia. In Indonesia and the Philippines it represents more than 20% of the total animal protein supply per capita, 20-30kg per capita/year in Indonesia and 30-60kg per capita/year in the Philippines, which is the highest value in Asia, second only to Iceland in the world. Supply of fish in the APEC region is 65% higher, per capita, than the world's average supply (APEC, 2012a; FAO, 2012a).

As the Asian and Pacific economies continue to grow, human diets will continue to diversify in the region posing a greater demand for fish as a source of animal protein. So far the most significant increases in annual per capita fish consumption have occurred in East Asia, from 10.6 kg per capita per year (1961) to 34 kg (2009), and South East Asia from 12.8kg per capita per year (1961) to 32kg per capita per year (2009). However, in some areas of South Asia fish consumption remains too low and its contribution to food security needs to be enhanced (FAO, 2012a).

1.2.2 Importance of small pelagic fish

Pelagic fish dominate fish captures in Asia and the Pacific, and there are sub regions where small pelagics dominate and they are the chief source of inexpensive protein for lower income

groups. In some of these sub regions small pelagic fish are preferred by taste and affordability and are the target-fished group, but there are sub-regions where small pelagics have become dominant as a result of fishing down the food chain. In either case, the proportion of small pelagic fish, considered as low value/trash fish by some, is increasing in captures across the region and this is being reflected in the increase in value and demand of these fish, and the little amount of discard or waste fish due to small size. There is a long and varied tradition of fish consumption that includes fish of all sizes, making small fish an important part of daily diets (Pagdilao *et al*., 1993; Lymer *et al*., 2008).

Small fish are more nutritious than big ones, they supply relatively higher amounts of minerals per unit of weight given that they are often consumed whole with bones and everything, providing exceptional quantities of calcium and other minerals (Thilsted and Roos, 1999). Some small fish species also contain more amounts of vitamin A. Also, small and fatty pelagic fish like small tuna, mackerel and sardines, are incomparable components for the diets of pregnant and lactating women, since they are the richest source of a type of fat necessary for the correct development of the brain in unborn babies and infants. The role of small fish to food security is therefore of key importance to food security (Lymer *et al*., 2008).

1.2.3 Indonesia and the Philippines as case study Economies

The APEC, through the Paracas Action Agenda 2010, encourages initiatives that aim to incorporate sustainably managed small pelagic fish for human consumption (APEC, 2010) due to their high nutritional value and affordability, characteristics that make them ideal in the battle against food insecurity.

Fish and fishery products are among the most traded food commodities (FAO, 2012a), with Indonesia and the Philippines between the top ten net exporters of fishery products in the Asia-Pacific region (Lymer *et al*., 2008), and among the top producers of small pelagic fish (FAO, 2011). These facts suggest both economies could be of great contribution to food security in the Asia-Pacific region through the provision of fishery products of small pelagic fish to the region. For this reason, Indonesia and the Philippines were selected as case study economies to assess the case of the contribution of small pelagic fish to food security within the Asia-Pacific region.

1.2.4 Small pelagic fish of Indonesia and the Philippines

Indonesia and the Philippines form part of the Coral Triangle, the most diverse marine ecosystem of our planet located in South-East Asia. Fish species in these economies are of remarkable diversity, for instance, 2,741 species of fish have been recorded in Indonesian marine waters and 2,500 species in the Philippines (Allen, 2007; Carpenter and Springer, 2004; Willette et al.; 2011, Suwarso, 2012).

It is within the Coral Triangle that we find the most important stocks of small pelagic fish of Indonesia and the Philippines. Small pelagics comprise a diverse group of fish that inhabit the upper surface layers of the water column above the continental shelf, in waters not exceeding 200m of depth. Generally they weight less than 500g in adulthood, and form schools that feed mainly on plankton, thus their preference for surface waters where they can be found in the air-water interface. This makes them strongly influenced by environmental conditions and therefore highly seasonal (Campos and Moreno, 1991; Pagdilao *et al*., 1993; Chavez *et al*., 2003).

The definition of species that belong to the small pelagic fish group is difficult and can vary from place to place since there are some species that may fall between the large and small pelagic categories. For the purpose of this study we will consider small pelagics to the species considered as such in the case study economies. These species include the definitive group of small pelagics for which no doubt exists, like the clupeoids (Fam. Engraulidae, Fam Clupeidae), scads (Fam. Carangidae), mackerels (Fam. Scombridae), fusiliers (Fam. Caesionidae), flying fish (Fam. Exocoetidae) and halfbeaks (Family Hemiramphidae), and will also include the small tuna (Fam. Scombridae) even though they fall in the margin between small and large pelagics because their production, uses and affordability are similar to those of small pelagics.

1.2.5 Fisheries classification in Indonesia and the Philippines

Both in Indonesia and the Philippines the fisheries sector is divided into two main categories that refer to the scale of their activity. However, since there is no universal standardisation for what can be considered small or large-scale fisheries, such definitions vary between the two economies (Table 1).

Table 1. Definition of small and large-scale fisheries in Indonesia and the Philippines

Definition	**Indonesia**	**The Philippines**
Small Scale	**Artisanal fisheries**	**Municipal fisheries**
	In coastal waters within 4nm (7.4 km) of the coastline, with or without the use of boats of 10 GRT or less. Managed by district authorities.	In coastal waters within 15 km of the coastline, with or without the use of boats of 3 GRT or less. Boats are classified into non-motorised or motorised. Managed by Local Government Units (LCUs).
Large Scale	**Commercial fisheries**	**Commercial fisheries**
	Fishing with the use of boats more than 10 GRT. Boats are subdivided into 2 categories: small (10-30 GRT) and large (>30 GRT). The former fish between 4-12 nm, managed by provincial governments, while the latter use waters outside the 12nm zone, managed by the central government.	Fishing with the use of boats more than 3 GRT, outside the 15 km municipal waters. There are three categories: small (>3-20GRT), medium (20-150 GRT), and large (<150GRT). All of them fish in waters managed by the central government.

1.3 Rationale and scope of the study

Rapid economic growth in the Asia-Pacific region has allowed for notable improvements on food security, particularly in South East Asia where the fastest improvement is observed. As a consequence, there is an increase in the consumption of fish protein in the daily diets of populations that are traditionally fish consumers. The Asia-Pacific region has very high levels of fish consumption, second only to Iceland in the world, and plays an important role in the trade of fishery products, including small pelagic fish products which are highly diverse and abundant in the region, especially in Indonesia and the Philippines.

The contribution of small pelagic fish to food security within the region seems unquestionable, however it is of concern that despite the improvements in food security and the increased consumption of fish protein, the largest number of undernourished people prevails in Asia-Pacific, as it is the region that contains the largest human population as well. Hence the demand for fish is very high, posing extra pressure to stocks that are already being overexploited and in apparent decline.

The state of food insecurity and the state of fisheries have been assessed in the region (Lymer *et al*. 2008,; FAO 2012a; FAO, IFAD and WFP, 2012), however the results of these assessments have not been converged and are kept general, they have not been punctually analysed for the case of small pelagics despite their evident contribution to food security, particularly for the livelihoods of fishermen who are vulnerable to food insecurity. In Indonesia there are 2.2 million fishermen, most involved in small pelagics fisheries, and in the Philippines small pelagics provide livelihoods to almost two million people (Green *et al*., 2003; Suwarso, 2012). Under this scenario it becomes of great importance to bring together this knowledge, and support it with primary data to achieve a first approximation of the real potential of small pelagic fish to contribute to food security in the Asia-Pacific region. Indonesia and the Philippines area taken as case study economies in their condition of top producers, consumers and net exporters of fishery products, particularly of small pelagic fish.

Finally, since food security depends on economic sustainability, as much as economic sustainability depends on adequate management of fisheries and the capacity to give added value to fishery resources, this project has a component of knowledge and technology transfer aimed at sharing experience in these areas.

1.4 Goal and objectives

The overarching goal of this project is to contribute to the long term food security in Indonesia and Philippines by offering a sustainable source of high-quality protein at low cost, providing examples to other APEC economies. The specific key objectives are to:

a) Analyse the existing data on capture, processing, and consumption of small pelagic fish within the APEC economies of Philippines and Indonesia and collect new data through surveys that will aim at understanding local consumption habits, levels of capture of small pelagic fish and identifying strategies to overcome market impediments for consumption of small pelagic species as well as the identification of novel products for human consumption.

b) Share the research and management techniques for monitoring and regulating small pelagic fisheries in Peru and to identify new programs that could be applied in order to help manage and regulate those fisheries.

c) Share the Peruvian experience with the APEC economies of Philippines and Indonesia in the following areas: (i) technology in the production of value-added products from small pelagic fish for human consumption (e.g., smoked, salted, paste, and other forms); and (ii) marketing strategies for promoting the use of small pelagic fish for human consumption.

2. Methodology

Six main fronts were used to assemble this project: (1) literature review on issues related to small pelagic fisheries and food security in Asia-pacific, (2) observational research, (3) analysis of fish extraction statistics, (4) consumer surveys, (5) interviews with key stakeholders, (6) and visit of the representatives from Indonesia and the Philippines to Peru for the exchange of knowledge and experience.

2.1 Literature review

Literature was collected through four channels. The initial search was for electronic sources through the World Wide Web, this considering that most of the available information would be in the form of 'grey' or unpublished literature. All searches focused on the terms 'small pelagic fish' in any combination with the terms 'food security', 'Asia – Pacific', 'Indonesia', 'Peru', 'Philippines'. Additional web searches were done for references found through the 'snowball system' in related literature. The target data to be extracted from literature included: species of human consumption and nutritional value, statistics of capture, export and import, the supply chain, management and monitoring of fish stocks, and laws and regulations of the Asia-Pacific region. The searches were general to increase the chance of finding data with a broader range.

More specific searches were done directly in the websites of involved stakeholder organizations such as that of the Bureau of Fisheries and Aquatic Resources of the Philippines – BFAR (BFAR, 2012), the National Fisheries and Research Development Institute – NFRDI (NFRDI, 2012), the Ministry of Marine Affairs and Fisheries of Indonesia – MMAF (MMAF, 2012), the Ministry of Production of Peru (PRODUCE, 2012), the Food and Agriculture Organization of the United Nations (FAO, 2012b), and the Asia-Pacific Economic Cooperation (APEC, 2013).

Visits to the libraries of stakeholder organizations and interviews with key stakeholders were also important channels providing access to literature otherwise unavailable. The libraries of the BFAR, the NFRDI, the MMAF, and the Research Centre for Fisheries Management and Conservation (RCFMC) from Indonesia, were important sources of literature.

The literature collected was separated into four categories: (1) statistics, management and policy, (2) human consumption habits, (3) biology and research, and (4) fish products.

2.2 Fish statistics

The data collected in the category of statistics was used to analyse the availability of small pelagic resources. Data was collected in Indonesia and the Philippines both from specific fishing ports and from national statistics reports. Only main ports for small pelagics were visited and some smaller landing areas. The data from fish landings provided by the fishing

ports not always coincided with the statistics of the national reports, so for the purpose of the study only official data from national reports was used to analyse capture.

The data on fish consumption, imports and exports was compared and analysed to assess quantitatively the potential of small pelagic fish to contribute to food security in Asia Pacific.

2.3 Consumer surveys

Consumer surveys were the main method used to obtain primary sources of data. The purpose of the surveys was to gather information of the populations' preferences for fish consumption. This data has not been collected or assessed before in detail by the case study Economies, hence the sample included informants from all the major socioeconomic and cultural groups, as well as from different geographic localities. It was intended to have 50% of the interviews conducted at fishing villages and 50% at non-fishing communities. Fishermen and housewives were interviewed indistinctively at fishing communities, however in non-fishing communities the objective group for the interviews will be housewives because they are more commonly responsible for deciding the daily menu by shopping for food and cooking.

Surveys consisted of semi-structured questionnaires to allow us to gather as much possible information without missing the final goal. The surveys were divided into four sections: (i) personal information, (ii) importance of fish in the diet of the interviewee's family, (iii) the degree of preference for the different fish available in the market, and (iv) the interviewee's reasons for her preferences on each of the species listed on the survey questionnaire .Since the usual references on food values are: (1) taste and other organoleptic factors, (2) social status, (3) price, and (4) health; through the surveys we tried to classify their choices into these options.

2.4 Observational research

Personal observations were done in ports, landing areas, processing sites, markets, family houses and restaurants to get a real insight of the scope of small pelagic fish. Observations of fishing techniques, gear, vessels, landings, handling, auctions, the supply chain, consumption habits and fish products were all recorded to enrich the discussion of the results of this study.

Observational research in markets was particularly important to compliment consumer surveys and get a more profound understanding of food and fish choices. Normally, interviewees are not able to identify the values that guide their preference because these are not explicit but part of a non-verbal implicit system of reference. Hence, from visits to we observed attitudes and shopping behaviour of costumers to reinforce the data obtained through surveys. Visits to markets also served to identify the offer of fish products.

2.5 Interviews with key stakeholders

Stakeholder interviews had the purpose of collecting knowledgeable opinions, issues and concerns that normally cannot be obtained through questionnaires and surveys. They aid to validate opinions that are consistent and to spot incongruences on a same topic. Interviews took place on a one to one setting, the interviewer and interviewee, plus a third local person to serve as an interpreter in case it was required. Time and place for the interview were scheduled by the case study Economies, normally at the offices or working sites of the interviewees. Questions were open-ended to reduce bias. Notes were taken during the interview and they were transcribed on the same or the next day, the overall impression of the interviewer was also noted. Interviews lasted about one hour.

Key stakeholders were identified from the following areas of interest of the project: small scale and industrial fishermen, fishing port managers, fish vendors, fish brokers, processing plant owners, capture fisheries, fish statistics, fish processing, port-harvest fisheries, marketing of fish products, fisheries monitoring and surveillance, and socioeconomics of fisheries. The stakeholders interviewed were identified and suggested by the case study Economies.

2.6 Visit of the representatives of the case study Economies to Peru

Representatives of Economies, Indonesia and The Philippines, travelled all the way to Peru to comply with the following objectives of the project:

b) Share the research and management techniques for monitoring and regulating small pelagic fisheries in Peru and to identify new programs that could be applied in order to help manage and regulate those fisheries, and

c) Share the Peruvian experience with the APEC economies of Philippines and Indonesia in the following areas: (i) technology in the production of value-added products from small pelagic fish for human consumption (e.g., smoked, salted, paste, and other forms); and (ii) marketing strategies for promoting the use of small pelagic fish for human consumption.

The visit was planned in direct coordination with the Vice-Ministry of Fisheries of the Ministry of Production of Peru, and the governmental fisheries research agencies of Indonesia and the Philippines that were assigned the project, the Research Centre of Fisheries Management and Conservation (RCFMC), and the National Fisheries Research and Development Institute (NFRDI) respectively.

During the stay of the representatives, visits took place to: (1) the Peruvian Technological Institute of Production (ITP) concerned with fish processing, (2) the Peruvian Marine Research

Institute (IMARPE), (3) the Vice-Ministry of Fisheries of the Ministry of Production, (4) fish markets and supermarkets, and (5) Paracas National Reserve.

A meeting was also organised to present and discuss the progress of the project, to share knowledge and experience, and to identify possible areas for the transfer of technology and knowledge regarding small pelagic fish.

3. Results and discussion

3.1 Limitations of the Study

3.1.1 Fish statistics

Statistical data about fish capture was collected directly from ports and also from governmental research agencies, which is probably the most accurate source of data due to greater surveying effort. However, these data was not used as it was not available for all species and did not include additional information to that of capture, plus it did not always coincide with that officially reported through the national official statistics so it was difficult to combine for analyses. Hence it was deemed better to conduct the analyses of fish availability based only on the official national statistics provided by each economy through their fisheries statistical reports. This data may not be completely consistent as methods change slightly through time, as well as surveying effort but they serve as good indicators of production and are consistent with the data of FAO, comparable to that of other economies freely accessible. Some species from the fisheries statistics reports used have even changed taxonomic identification; this has been overcome by using the standardised categories of fish species or groupings used by FAO (2011) following the ASFIS nomenclature, except for a few cases where the data available from the national statistics has more detail.

3.1.2 Consumer surveys

Due to time, budget and logistical constraints, consumer surveys could not be exhaustive and completely representative of the realities of Indonesia and the Philippines. The territories of both economies are of archipelagic nature, imposing great challenge for this kind of research; still, the main areas of small pelagic fish production were covered capturing the state of these fisheries and the reality of coastal non-fishing and fishing communities. To cover for other regions, an online survey was disseminated, however this part can still be improved by increasing survey effort, given the appropriate time and budget for planning.

Survey effort was variable between the two economies, and even among the sites surveyed within a same economy. This was greatly due to language difficulties and was tackled with the support of local staff from fisheries agencies at all times. However, in Indonesia people that

speak English are a minority, especially in the provinces, so it was more difficult to conduct the surveys even though local staff provided a great deal of support. Yet, the minimum target for field surveys was covered. In the Philippines language was less of a constraint since the majority of people understand English, so surveys were more fluent. Also in the Philippines, the network of fish enumerators across landing sites helped largely conducting costumer surveys, hence the significantly larger number of surveys for the Philippines.

References to fish in the consumer surveys were general; it was not possible to have the detail of the species consumed, as most people know fish through their general common names but are unable to identify specimens to the species level. That level of detail would have required a greater effort, probably with the same results. Still the data collected is perfectly utilisable for analyses.

3.2 Completion of the project objectives

The objectives set by the project were successfully met:

a) Data on capture, processing and consumption of small pelagic fish within the APEC economies of study was collected and analysed to understand local consumption habits, levels of capture of small pelagic fish and identifying strategies to overcome market impediments for consumption of small pelagic species as well as identifying novel products for human consumption. All described in the following sections.

b) The research and management techniques for monitoring and regulating small pelagic fisheries in Peru were shared during the visit of the case study representatives to Peru. New programs that could be applied help manage and regulate the case study fisheries were also identified. Details of the meeting's achievements are also presented in the following sections.

c) The Peruvian experience was shared with the APEC economies of Indonesia and the Philippines in areas of: (i) technology in the production of value-added products from small pelagic fish for human consumption (e.g., smoked, salted, paste, and other forms); and (ii) marketing strategies for promoting the use of small pelagic fish for human consumption. Details are also presented in the following sections regarding the visit of the case study representative to Peru.

The sections that follow of this discussion present the key outputs and outcomes of the project as per the objectives of the project expressed above.

3.3 Availability of small pelagic fish in Asia-Pacific

3.3.1 Statistics of fish of commercial value

Official capture statistics in INA are based on the top 91 most productive species in terms of volume, which account for 85.3% of the total volume of fish captured in marine waters (MMAF, 2011); while in the RP, capture statistics include the top 30 species which represent about 88.3% of the total species caught in marine waters (BAS, 2011), this between the decade of 2000-2010. In both economies, the remaining percentages include fish with much lesser contributions, which are aggregated in the category of other fish. The smaller number of species included in the statistics of the RP – 30 species – account for a higher production volume than the 91 species of INA, suggesting species of commercial value from INA are more diverse. The species included in the list of species and statistics of INA but not considered for the RP, are also the least productive of Indonesia with capture volumes below 50,000 MT.

3.3.2 Small Pelagics Fisheries Production in Asia-Pacific

Out of the total volume of marine fish species captured, small pelagics contributed with an average of 46.9% in INA and 58.7% in the RP for the years between 2000-2010. In 2010 alone, small pelagics in INA accounted for 45.6% and in the RP for 57.8% of the total volume of marine fish capture production, showing a very small decline from the average proportion of the last decade (BAS, 2011; MMAF, 2011). Despite this small decline, overall production of small pelagics in both economies shows increasing and similar trends with a reduction on the pace of increase only in recent years, where it appears to be reaching a constant horizontal asymptote (Figures 1 and 2). Fish that are not small pelagics also show an increasing trend, which in the RP is similar to that of SPF, while in INA the trend is more accelerated than the increase of SPF. Small pelagic fish and non-SPF in Indonesia have close capture levels but in the RP production is significantly higher in SPF, in any case SPF outpace the contribution of other fish groups. On the other hand, the category of other fish shows an almost constant trend over the years with a far less production than the other groups.

Only for the RP it is possible to compare SPF production from small-scale (municipal) and large-scale (commercial) fisheries. For Indonesia only total production statistics are available, with no distinction of the small and large-scale sectors, so this type of comparative analysis is not possible. In the RP, commercial fisheries rely more on SPF than small-scale municipal fisheries do. On the last decade SPF have contributed to marine fish commercial production with an average of 67% of the total volume produced, non-SPF species with an average of 26% and 6% from other fish. Regarding small-scale municipal fisheries, the difference between the two categories is not that big but still small pelagics contribute significantly more with 49% of the production, while non-SPF contribute with 33% and other fish with 16%. . It is to note that these values represent averages of each category for the last decade so they do not add-up to a hundred per cent. The production of other fish by municipal fisheries more than doubles that of commercial fisheries. In both sectors, commercial and municipal, SPF and non-SPF show an

increasing trend over the years, while the category of other fish remains almost constant (Figures 3 and 4).

Figure 1. Trend of the contribution of small pelagic fish to marine fish production in Indonesia from 1997 – 2010

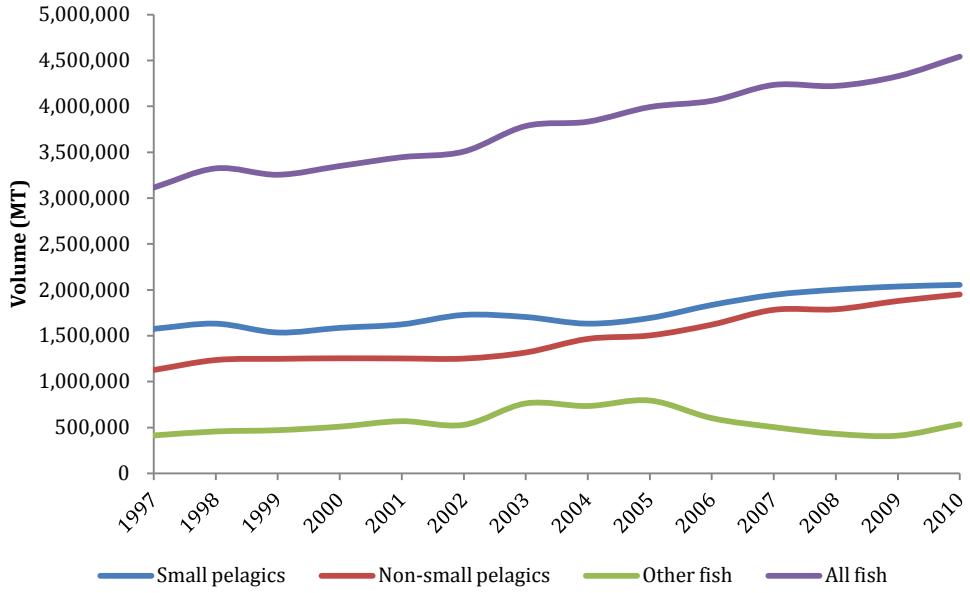


Figure 2. Trend of the contribution of small pelagic fish to marine fish production in the Philippines from 1997 – 2010

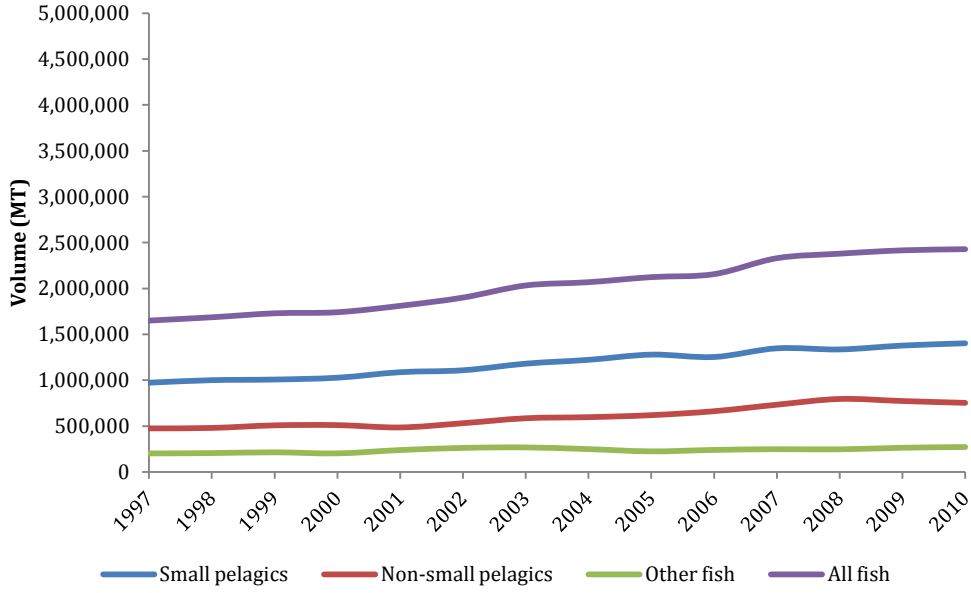


Figure 3. Trend of the contribution of small pelagic fish to commercial marine fish production in the Philippines from 1997 – 2010

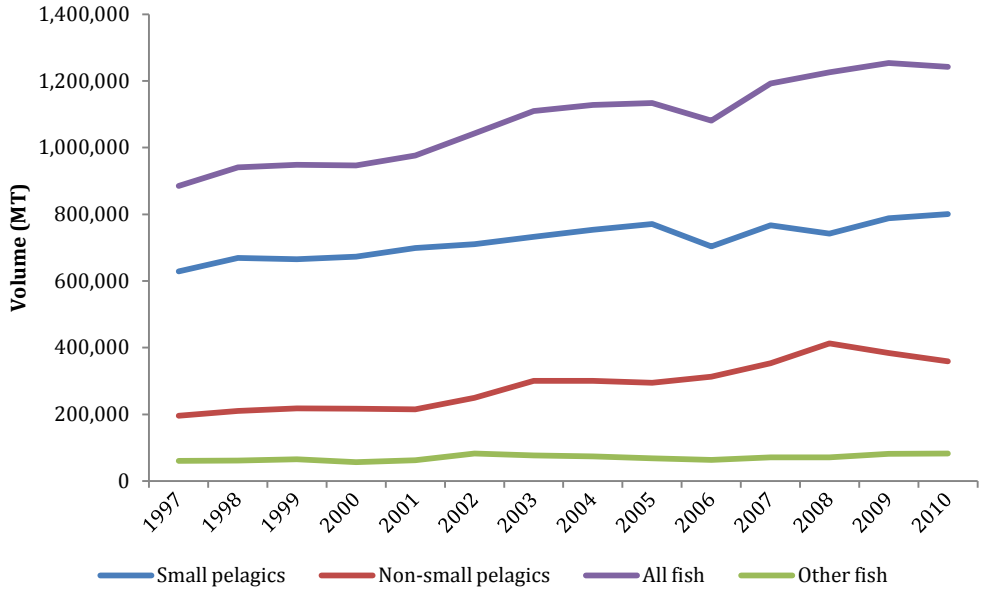
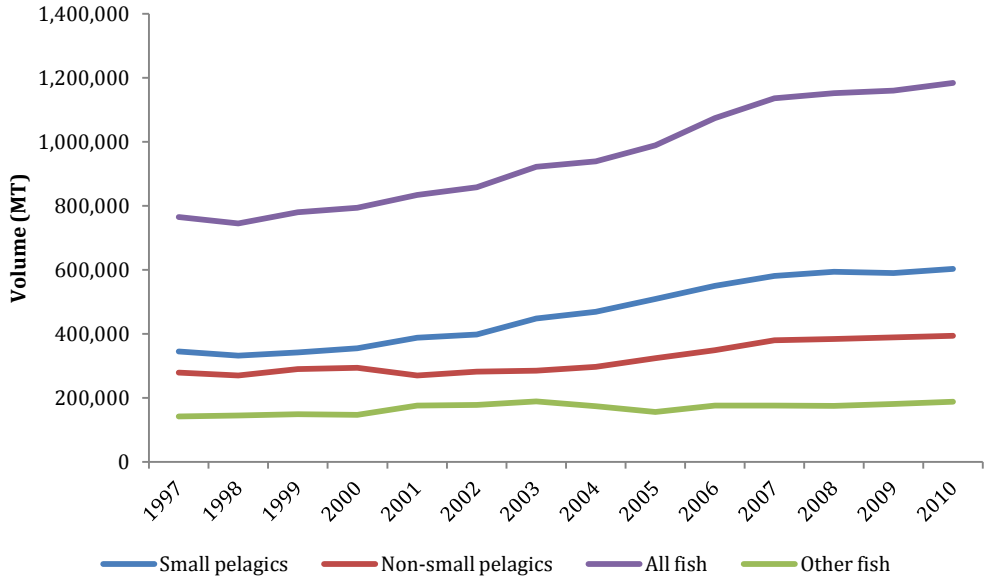


Figure 4. Trend of the contribution of small pelagic fish to municipal marine fish production in the Philippines from 1997 – 2010



3.3.3 Species composition and contribution to small pelagic fisheries

The list below (Table 1) presents the species of SPF that form part of the top species presented by each economy in their national fisheries statistics (BAS, 2011; MMAF, 2011). Based on these species, availability of SPF was assessed. Before entering into more detail of SPF species, it is important to note that there are single species of small pelagics that contribute with a significant proportion of production out of the whole marine species captured. In 2010, the top fish species captured that contributed with 3% or over of the total marine fish production added a total of 12 species in Indonesia and 10 species in the Philippines, of which 9 and 7 species were small pelagics respectively, demonstrating the dominance of single species of SPF in marine fish production. These species are highlighted in figures five and six with their respective production proportions, and show the overall importance of SPF in marine fish production.

Table 1. List of small pelagic fish considered among the top production fish species of Indonesia and the Philippines

Nº	English names	Indonesian	Filipino	Scientific name
1	Redbelly yellowtail fusilier**	Ekor kuning/Pisang-pisang	Dalagang-bukid	*Caesio cuning*
2	Blue and gold fusilier**	Lolosi biru	Dalagang-bukid	*Caesio caerulaurea*
3	Yellowstripe scad	Selar	Salay-salay	*Selaroides spp*
4	Jack trevallies	Kuwe	Talakitok	*Caranx spp*
5	Round scads	Layang	Galonggong	*Decapterus spp*
6	Torpedo scad*	Tetengkek	Oriles	*Megalaspis cordyla*
7	Bigeye scad	Bentong	Matang-baka	*Selar crumenophthalmus* *Selar boops*
8	Dorab wolf-herring*	Golok-golok	Parang-parang/Balila	*Chirocentrus dorab*
9	Chacunda gizzard shad*	Selanget	Kabasi	*Anodonstoma chacunda*
10	Spotted sardinella*	Siro	Tunsoy	*Amblygaster sirm*
11	Rainbow sardine	Japuh	Tulis	*Dussumieria acuta*
12	Goldstripe sardinella	Tembang	Tamban	*Sardinella fimbriata* *Sardinella gibbosa*
13	Bali sardinella	Lemuru	Tamban	*Sardinella lemuru*
14	Hilsa shad*	Terubuk	-	*Tenualosa ilisha*
15	Stolephorus anchovies	Teri	Dilis	*Stolephorus spp*
16	Flying fish	Ikan terbang	Bolador	*Cypselurus spp*
17	Garfish and Halfbeaks*	Julung-julung	Buging/Kansusuit	*Hemirhampus spp*
18	Bullet tuna*	Lisong	Tulingan	*Auxis rochei*
19	Frigate tuna	Tongkol krai	Tulingan	*Auxis thazard*
20	Kawakawa	Tongkol komo	Katchorita	*Euthynnus affinis*
21	Short mackerel	Kembung	Hasa-hasa	*Rastrelliger brachysoma*
22	Indian mackerel	Banyar	Alumahan	*Rastrelliger kanagurta*
23	Narrow-barred Spanish mackerel	Tenggiri	Tanigue	*Scomberomorus commerson*
24	Indo-Pacific king mackerel*	Tenggiri papan	Tanigue	*Scomberomorus guttatus*

* Species not included as top species for the Philippines

**Aggregated in the category *Fusiliers* in Philippine statistics

Figure 5. Contribution of small pelagic fish species to the top most productive marine fish in Indonesia, 2010

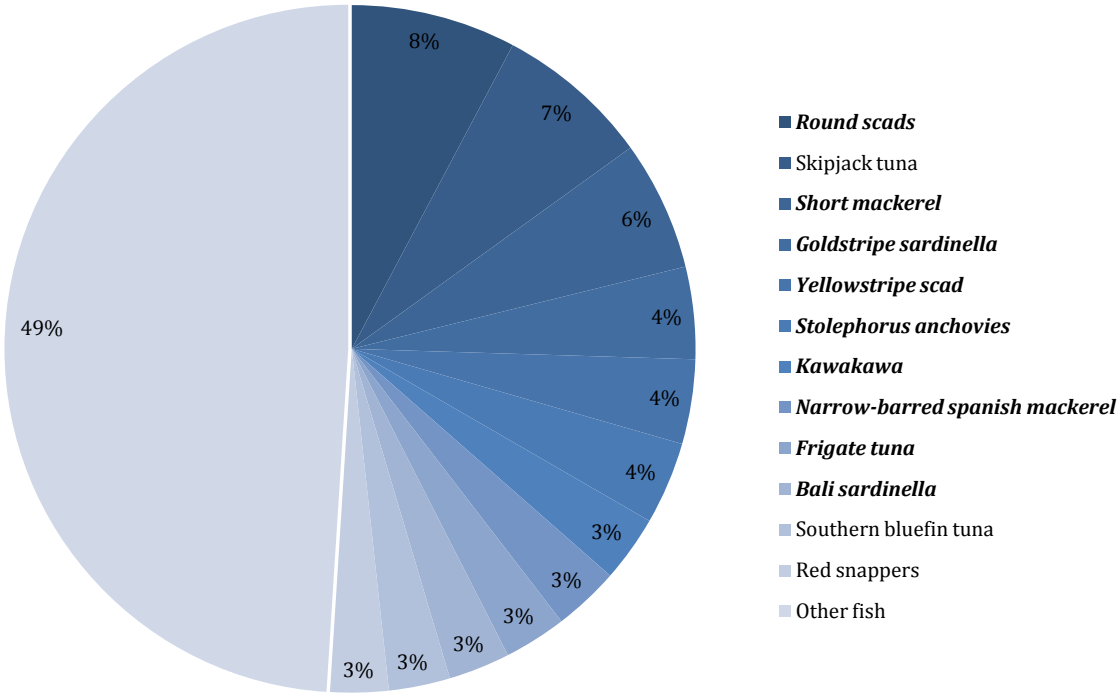
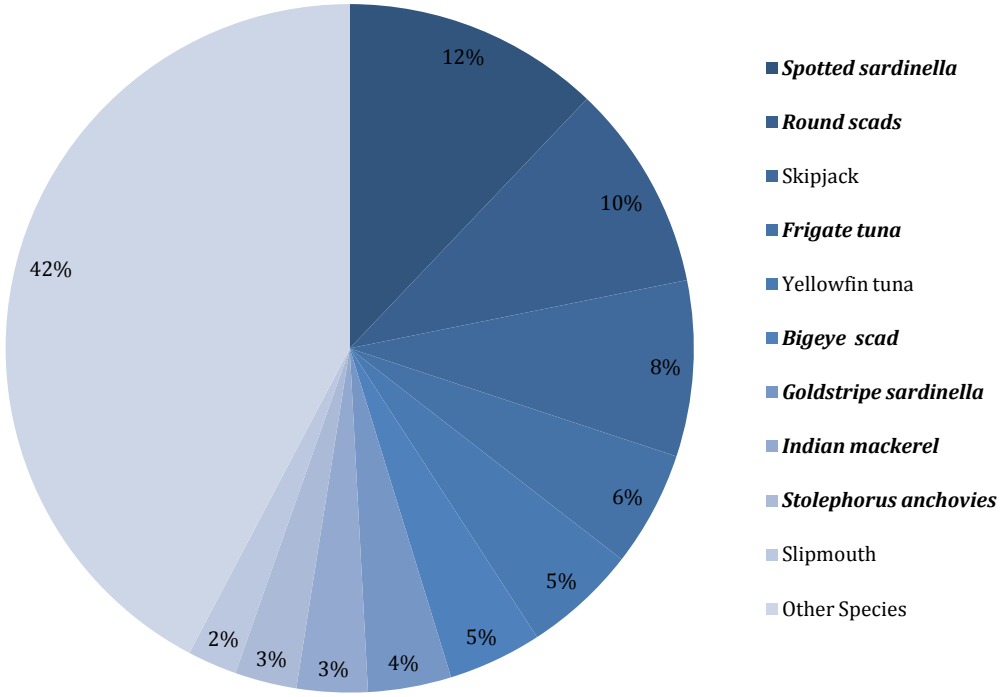


Figure 6. Contribution of small pelagic fish species to the top most productive marine fish in the Philippines, 2011



Year 2010 only was taken as reference to analyse species composition, the contribution of individual species follow a similar trend over the years so this should not have a significant difference on the results.

Indonesian fisheries appear to be overall more diverse if we consider the higher number of commercial species that make up the top production species; however analysing only small pelagic fish, 90% of the total volume captured is composed of a similar number of species in the two economies, indicating diversity of small pelagic fisheries is not that different. Nevertheless, the production proportion of each species is more evenly distributed in INA than in the RP, showing a slightly higher diversity. In Indonesia it takes 5 species of small pelagic fish to add-up to 50% of the SPF production, while in the Philippines only three species cover for over 50% of this production (Figures 7 and 8). This apparent higher diversity could also be a reflection of the higher volumes of capture in Indonesia and therefore increased probabilities of capturing diverse species. In any case, small pelagic fisheries of these economies have a high diversity.

In INA, eleven species count up for 90.2% of the small pelagics production while the remaining 9.8% is composed of other thirteen species, each contributing with less than 3%. The total production volume of these top ten species is 1,854,603 MT (Figures 1 and 7).

In the RP, ten species account for 92% of the volume of small pelagics captured, with 5 species making up for the remaining 8%, all with contributions below 3%. The total production volume of these top ten species is 1,290,841 MT (Figure 2 and 8).

These top producing species that compose over 90% of the capture in volume are shown in the table below for comparison (Table 2), and are the species analysed for trends (Figure 9 and 10).

Table 2. Production volumes of the top small pelagic fish species in Indonesia and the Philippines, 2010

Indonesia		The Philippines	
Species	**Volume (MT)**	**Species**	**Volume (MT)**
1. Round scads	351,216	1. Spotted sardinella	334,030
2. Short mackerel	276,110	2. Round scads	268,227
3.Goldstripe sardinella	196,067	3. Frigate tuna	149,566
4. Yellowstripe scad	179,940	4. Bigeye scad	121,522
5. Stolephorus anchovies	175,726	5. Goldstripe sardinella	108,015
6. Kawakawa	141,190	6. Indian mackerel	91,857
7. Narrow-barred Spanish mackerel	140,277	7. Stolephorus anchovies	80,183
8. Frigate tuna	132,733	8. Short mackerel	55,708
9. Bali sardinella	131,137	9. Yellowstripe scad	43,497
10. Jack trevallies	70,317	10. Kawakawa	38,236
11. Redbelly yellowtail fusilier	59,890		
Total	**1,854,603**	**Total**	**1,290,841**

Figure 7. Top small pelagic fish species in Indonesia, 2010

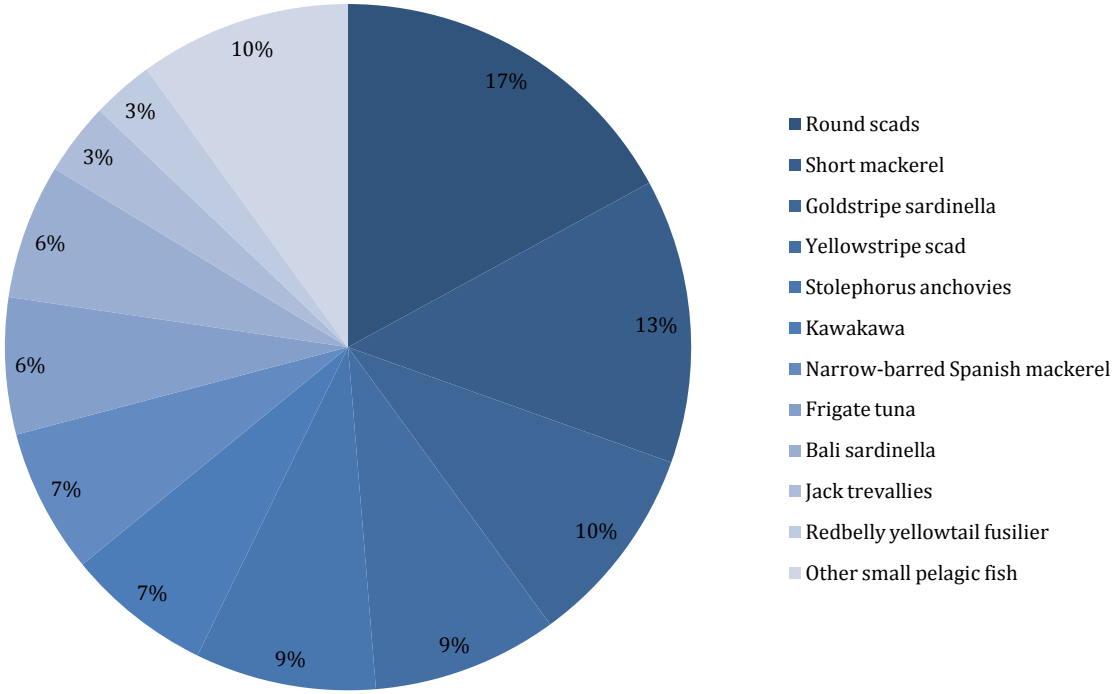
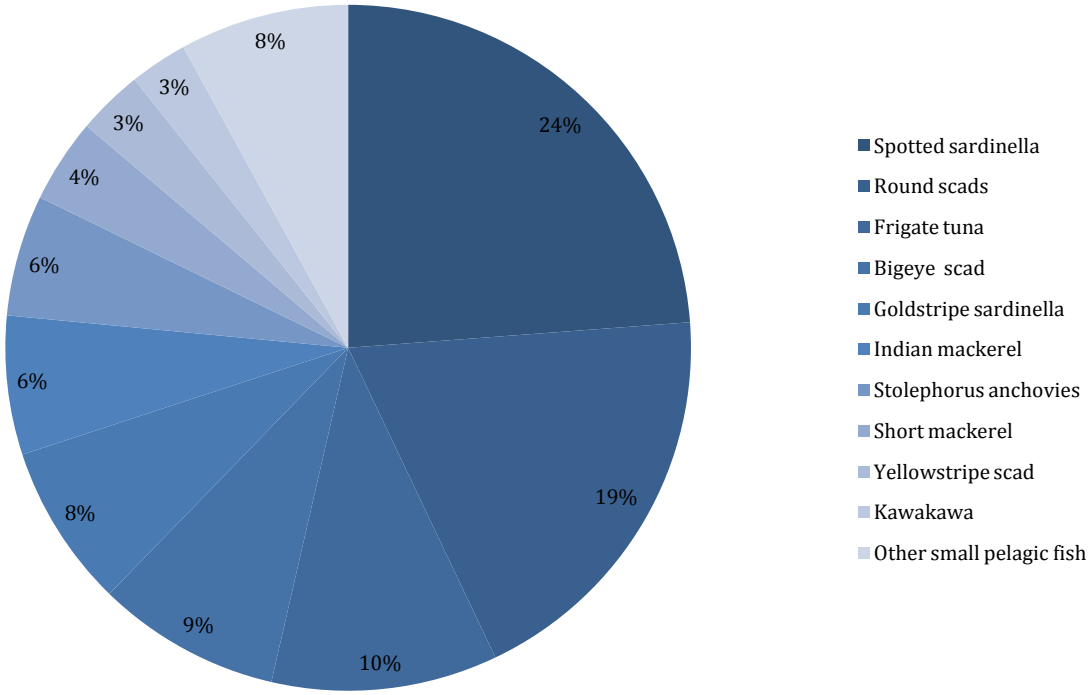


Figure 8. Top small pelagic fish species in the Philippines, 2010



3.3.4 Production trends of top species of small pelagic fish

Most of the top species have a similar trend in production; they show slow paced overall increase but with oscillations from year to year, like those made by pendulums but with an increasing trend with time (Figures 9 and 10). Many species have production volumes that are very strongly correlated, with Pearson coefficients of correlation above 0.80; a summary of the top species with very strong correlation is found in Table 3. Note that correlation, when strong, is always positive for the top species analysed, confirming the generalised increasing trend of these species.

This increasing oscillatory trend occurs in species of INA and the RP, except only for a few species. In Indonesia, the species that is an exception to this pattern is the kawakawa which shows an overall decrease instead, with an abrupt fall in production from 2003 to 2004 and 2005, thereafter production improves still oscillating, but does not recover completely, its does not reach the previous values from 2003. The frigate tuna at first glance appears to be an exception with a different trend, however this is a result of the lack of statistical data before 2004. From 2004 until 2005 the increase is abrupt, with an overall oscillating increase for future years just like the other species analysed, and this is confirmed by its strong positive correlation with the yellowstripe scad, which clearly follows the general pattern (Table 3).

In the RP all species show an increasing oscillating pattern (Figure 9). Only the short mackerel appears to have a slower increase without much apparent oscillation, this is due to the smaller volume captured which at the scale analysed shows little oscillation. Species with larger production levels exhibit larger oscillation ranges. Usually, the larger the production is, the larger the oscillations experienced by the species. All other species from the RP oscillate, but in contrast to the oscillations shown by the species in INA, the oscillation ranges in the RP are more varied. In the RP three top species have the major and more abrupt oscillations, while the rest of the species with lower productions show smother oscillations. This higher oscillation observed in higher production species could also be the result of higher levels of exploitation that decimate fish populations which then require more time for recovery.

Figure 9. Production trend of the top small pelagic species of Indonesia from 1997 - 2010

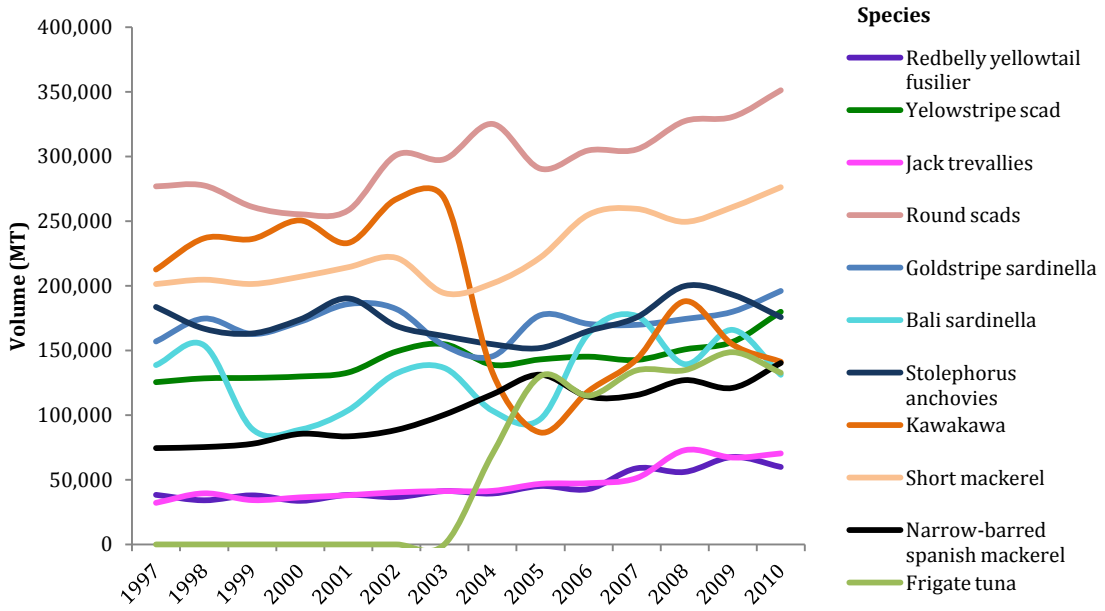


Figure 10. Production trend of the top small pelagic species of the Philippines from 1997 - 2010

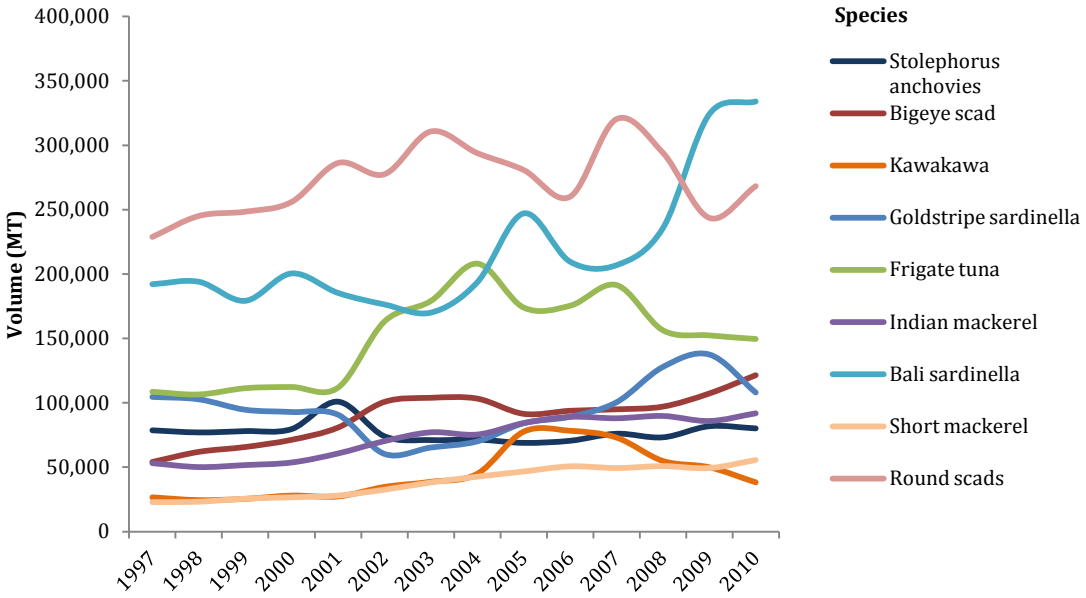


Table 3. Species of the top small pelagic fish highly correlated, 2010

Species 1	Species 2	Coefficient
Indonesia		
Redbelly yellowtail fusilier	Jack trevallies	0.89
Redbelly yellowtail fusilier	Yellowstripe scad	0.85
Jack trevallies	Short mackerel	0.85
Round scads	Yellowstripe scad	0.84
Round scads	Narrow-barred Spanish mackerel	0.83
Jack trevallies	Narrow-barred Spanish mackerel	0.82
Goldstripe sardinella	Frigate tuna	0.81
Redbelly yellowtail fusilier	Frigate tuna	0.80
The Philippines		
Indian mackerel	Short mackerel	0.98
Yellowstripe scad	Indian mackerel	0.95
Yellowstripe scad	Short mackerel	0.90
Bigeye scad	Indian mackerel	0.86
Bigeye scad	Short mackerel	0.84
Narrow-barred Spanish mackerel	Short mackerel	0.82
Yellowstripe scad	Frigate tuna	0.80

Again regarding differences between the small and large-scale sectors on the production trends of single species, there is only available information for the RP.

Figure 11. Production trend of the top small pelagic species of the Philippines by commercial fisheries from 1997 - 2010

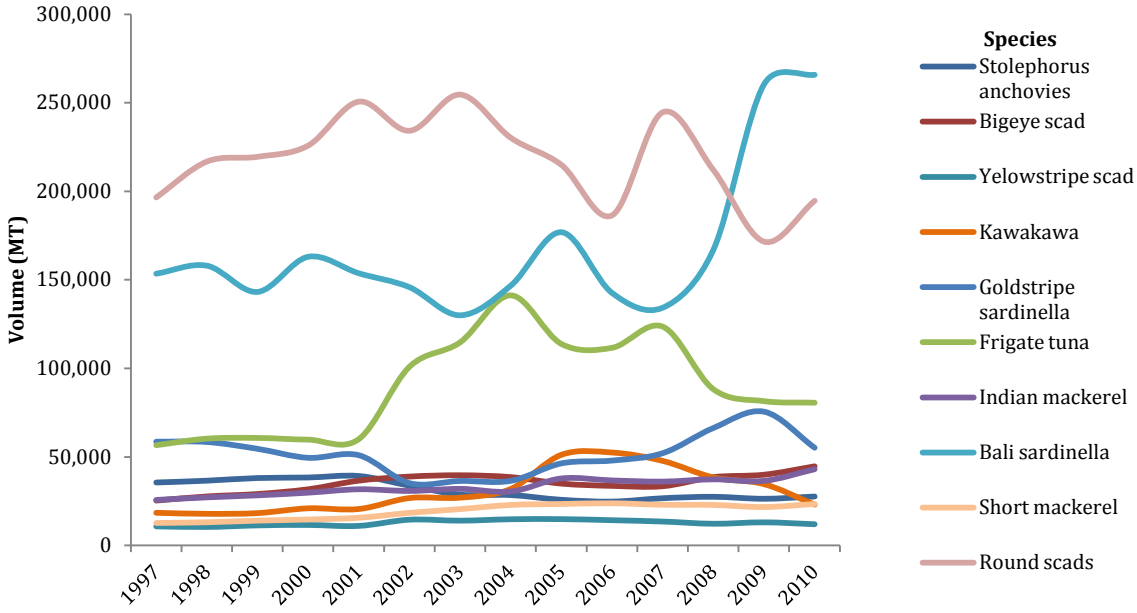
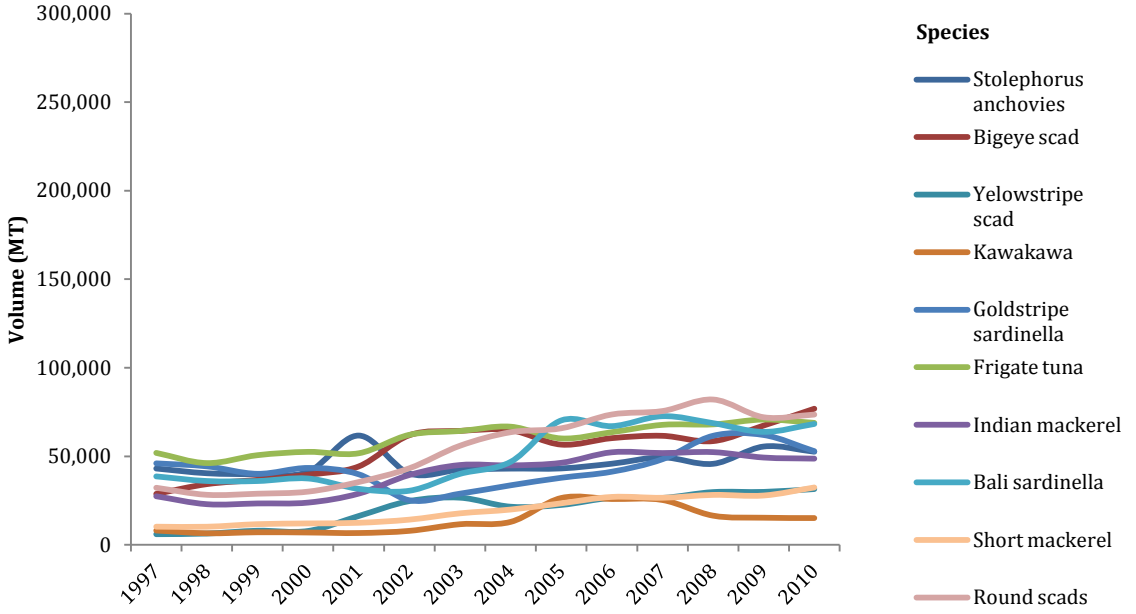


Figure 12. Production trend of the top small pelagic species of the Philippines by municipal fisheries from 1997 - 2010



Trends of commercial fisheries in the RP are very similar to its overall trends, demonstrating a notorious dominance of three species, round scads (*Decapterus* spp.), Bali sardinella (*Sardinella lemuru*) and frigate tuna (*Auxis thazard*). For municipal fisheries a production is more evenly spread among species, capture levels are significantly lower but multispecies directed with smooth oscillations between years.

3.3.5 Sustainability of small pelagic fisheries

Just by analysing fish production statistics of SPF the prospect contribution to food security seems promising, as the predominant production pattern of SPF species in Indonesia and the Philippines is of continuously increasing trends for almost all species. However, the decline of the small pelagics yield is a fact in both economies and many of the dominant species stocks are already declining (Dalzell et al., 1987).

In the RP, by 1956, catch per unit effort of small pelagic fisheries started it relentless decline (Barut, 2003). In 1989, Pauly and Silvestre stated that the RP had well exceeded the estimated maximum sustainable yield (MSY) with an annual rate dissipation of about US$290 million for small pelagics (Trinidad, 1993). Most of the Philippines' coastal fishing grounds are already overexploited. The MSY of capture fisheries production of small pelagics, estimated at 550,000 MT (Dalzell *et al*., 1987), has been greatly surpassed, even doubled for the last decade and maybe longer (figure2, table 2). Iconic species of food security such as scads, sardines and anchovies declined due to poor or non-existent management, resulting on sharp price increases adding further stress to food security. To ensure food security it is necessary to ensure supplies, by promoting sustainable fisheries (Green *et al*., 2003).

Prospects are hopeful with appropriate management, stock assessments of sardine fisheries, which are among the most important fisheries nationally in the RP, show that the sardine stocks are healthy at the national level despite of depletion indicators for certain fishing grounds that face heavy fishing pressure of particular stocks. For instance, *Sardinella gibbosa*, *Sardinella fimbriata* and *Sardinella lemuru* are overexploited in western and central Visayas, reporting fish with length data below the standard length at first maturity, while the species as a whole has healthy stocks in other grounds (Guanco *et al*., 2009). The spotted sardine *Amblygaster sirm* is another example of localised overexploitation at Honda Bay in Palawan where the species has been fished above optimal levels experiencing overexploitation, whilst other areas experience moderate or less pressure over the resource (Ramos *et al*., 2009).

Management tools so far have proved successful in recovering sardine captures in the Philippines. In December 2011 a closed season for the conservation of sardines was ordered in the East Sulu Sea, Basilan Strait and Sibuguey Bay until March 2012, the three following years the closure for sardines would be repeated for three months from November 1st until February 1st to avoid the capture of juveniles. It took a long process of education and strong political will to achieve this closure.

In INA, the target for managing fisheries resources is to develop fisheries until an exploitation level at 80% of the MSY. By 1997, overall production from the marine sector was approximately 57% of the MSY, erroneously indicating that the marine fishery production could increase safely while in reality fish stocks in some areas were already exposed to high levels of exploitation and some were already over exploited particularly in the case of coastal stocks, with exploitations above the MSY with ever decreasing captures per unit effort. The Bali sardinella in the Bali strait is an example of a highly overfished stock (Potier, 1995; FAO, 1999).

The National Commission of Fish Stock Assessment (NCFSA, 2011) of INA shows that the status of small pelagic fisheries resources in 2010 follows a similar pattern of overexploitation to that of the Philippines, with four out of the eleven fishing management areas overexploited for small pelagics. Stocks of the Bali sardinella, Indian mackerel, short mackerel, round scads and the goldstripe sardinella are overexploited as of year 2010. However closures for small pelagics have not been possible, in 2001/2002 the North Central Java Sea was proposed for closure to allow stocks of small pelagics to recover but it resulted in mass demonstrations of fishermen that do not have other source of livelihood, so the ban could not proceed (Suwarso, *pers comm*). The population of fishermen in Indonesia exceeds 2.2 million people, most of them will oppose to measures that neglect them from fishing, even for short periods of time. Hence political will is key for the successful implementation of drastic and necessary management measures such as fishing closures.

In any case, it is important to bear in mind that overfishing can potentially trigger a general decline and collapse of the fishing stocks, particularly if excessive fishing occurs during the early years of a species rise to dominance (Schwartzlose *et al*., 1999).

3.4 Human consumption habits of fish in Indonesia and the Philippines

Human consumption of fish in INA and the RP is comparatively high, even compared to other economies in Asia-Pacific their consumption values remain high, particularly in the Philippines. Iceland is the only world region with higher consumption values of fish, and Iceland is a very particular case due to its geography and reduced population as compared to Asia. Per capita consumption of fish in the Philippines as of 2010 was 38 kg/year and in Indonesia it was 30 kg/year (BFAR, 2011; MMAF, 2012). These figures represent national statistics collected through population census and include all fish and fishery products. In the following paragraphs we present the analyses and results of the primary data collected that form part of the project's objectives and outputs.

A total of two hundred and sixteen consumer surveys on fish preferences were conducted between Indonesia and the Philippines (Table 3). The number of surveys in the Philippines more than tripled that of the surveys obtained from Indonesia because of the ease of language in the Philippines and also due to the intensive support and effort provided by staff of the NFRDI to conduct the surveys, particularly by the network of enumerators. Due to time and

budget constraints, the minimum targeted number of surveys per economy was 60, 30 for coastal fishing communities and 30 for coastal non-fishing communities. Surveys in non-coastal communities were included later as it was observed that greater representation of each economy was required to get a more realistic scenario. Nonetheless success with non-coastal communities was not as good, we obtained the 30-survey target in the RP but results from INA were too poor.

Table 3. Surveys

Surveys	Indonesia	The Philippines	**Total**
1. Coastal Communities			
- Fishing community	24	44	68
- Non-fishing community	27	85	112
2. Non-coastal community	1	35	36
Total	**52**	**164**	**216**

From all the surveys conducted we get that in the coastal communities of INA and the RP altogether, fishing and non-fishing communities assessed together have a very high consumption frequency of fish; 74% of the people interviewed consumes fish daily, 24% weekly and only 2% monthly. All of the interviewees consumed fish and very often, the least did on a monthly basis, and many those who consume fish daily have the habit of eating fish three times a day everyday. On the other hand, the surveys obtained from non-coastal communities in the RP, mostly from big cities, had habits that differed greatly as the proportion of people who ate fish daily ascended to 41%, almost half of that in coastal communities. Those who consume fish weekly were the most, 53%, and 6% consumed fish annually. The monthly category was not mentioned by respondents, it seems in the cities people either consume fish often or do not consume it much, while in coastal communities it is a very common habit. The results from either coastal or non-coastal areas remain quite high.

On the question of fish as staple food we found it was important to present the results of the coastal communities of the two economies separately, as they vary significantly. While in INA 9% of the respondents considered fish a staple food, in the RP 28% considered it a staple food; even though frequency of consumption is very high with a high proportion of respondents eating fish daily it is strange to note it is not considered a staple food. More surprisingly is the fact that in non-coastal communities 82% mentioned fish as a staple food, though their consumption frequency was not reported that high. This could be a reflection of the common habit of consuming fish soup or fish chowder with every meal as a side, which may confuse respondents who do not know whether to classify the fish soup as a staple or not.

On the main source of protein, coastal communities of INA had fish as the top source with 64% of the votes; the RP also had fish as the top protein source in coastal communities with 74% of the votes. Instead in non-coastal communities of the RP the results were quite contrasting, the top source of protein was pork, voted 29% followed by fish with only 18%.

About the preferred fish over all species we have that in the coastal communities of Indonesia the small tuna and the Bali sardinella are the favourite species, in the coastal communities of

the RP small tuna are also preferred alongside round scads, and in the non-coastal areas of the RP the to preferred species is the bigeye tuna, not a small pelagic species in this case but we have that the species that follow in preference are the round scads, Indian mackerel and the popular small tuna.

Regarding the most commonly consumed species in Indonesian coastal communities it is again the small tuna, followed by the narrow barred Spanish mackerel and the round scads. In the RP the most commonly eaten species in coastal communities are the round scads, sardines and big eye scads, and in the non-coastal areas the most commonly eaten species are the bigeye scad, round scads, Stolephorus anchovies and siganid (not a small pelagic species).

We can see small pelagics dominate preference and are also among the most common species to eat, only for the case of non-coastal communities we have non-SPF species mentioned but still SPF species dominate.

When asked about the reasons for the selection of the preferred species results were the same as for the most commonly eaten species, the reason that guides choice is taste, followed by availability, affordability, and fleshy meat.

Out of the small pelagic fish only, the top rated species were the Stolephorus anchovies, sound scads, bigeye scad, and Spanish mackerel; while the least rated species where the rainbow sardine and the flying fish. The rainbow sardine chiefly because it is not commonly available and the flying fish because of its appearance that is not appealing for consumers.

3.5 Limitations and opportunities of value-added products of small pelagic fish to food security

3.5.1 Limitations

The greatest limitation to value-added products of SPF to tackle food security is posed by the archipelagic nature of Asia-Pacific in general. For instance, in INA the territory is segregated into over 17,000 islands and in the RP in more than 7,000 islands, this represents quite a challenge especially when aiming for the resource to reach isolated and land locked areas. A similar difficulty is also found in Peru due to the high Andes. So physical accessibility is a key limitation.

The fact that small pelagic fish are already readily available, cheap and freshly caught as food, especially in the coastal communities can be considered a further limitation. Artisanal processed SPF species are also common and highly affordable, hence the introduction of value-added products from small pelagic fish, particularly in coastal communities where SPF consumption is high, might be a difficult task.

The recovery of the capital invested in value-added products of SPF generally slow unless a very good quality product is made available. Lack of capital to process the fish is also a huge limitation, investors will most certainly overlook slow return initiatives, especially if we consider small pelagic resources are highly seasonal and unpredictable, and processing initiatives require a constant supply for production at least to start with. Plus some of the top producing species like sardines can reach high prices on themselves without processing.

Fish handling and general post harvest practices in Asia-Pacific need to be improved, more in the case of INA. The low quality of a great part of the SPF resources fished is an important limitation for production, the lower the quality the greater the volumes captured required to make fishing rentable. This goes against any sustainability efforts of the resource. Greater effort is required to improve post harvest and handling practices. Storage needs to be improved further with on-board chilling. In INA the number of vessels that keep cold storages for small pelagic fish is too low and in the RP it could be improved. Most small pelagic species are very fragile and difficult to store in adequate conditions, they deteriorate quiet rapidly due to their high oil content that accelerates rancidity. Cold storages should be basic minimum requirements for small pelagics fishing vessels, especially if their produce is for direct human consumption. This would increase the quality of the resources captured, probably the price too, and would reduce the fishing capacity of vessels posing less pressure over the small pelagics fish stocks.

There is also an increasing demand for small pelagics to be used as fish feed and or bait for mariculture. As the mariculture sector continues increasing, the pressure imposed on small pelagics will also be greater as well as competition with direct consumption.

3.5.2 Opportunities

There is a historically established preference for strong flavoured fish like small pelagics in Asia-Pacific. Therefore a wide array of value-added products exists, more in the form of artisanal produce. Supply includes small pelagics freshly caught, canned, salted, dried, smoked and marinated. This preference should be key for the use of value-added affordable produce from small pelagics.

Production of small pelagics follows a continuous increase for the last decade, indicating availability of the resource. Production can be very high during peak seasons of production, period that could be used to collect raw materials given that adequate storage is provided. This technology is already available in the Philippines and could be adapted in INA to allow SPF to be stored for longer periods of time and then they could be traded in isolated or land-locked communities.

There is a clear fish production deficit in INA and the RP; consumption demand by the population is higher than production levels of the national supply. This could be positively

addressed by surplus SPF producing economies like Peru and Chile, which could supply SPF for direct consumption to satisfy the internal demand of INA and the RP.

Artisanal value-added products like salted, dried, smoked, crackers and marinated SPF are of key cultural value and employ a great majority of the population of smalls-scale fishing communities. There is a potential working force to develop a value-added industry of small pelagics. Most producers work from home where women play an important cultural role and are the keepers of ancestral knowledge in this activity. Correctly encouraged, artisanal production of value-added small pelagic should serve to empower women in the Asia-Pacific society, improve production quality and safety issues and reduce losses due to poor handling.

4. Conclusions

Assessing the potential contribution of SPF to food security is a very ambitious endeavour that requires analysis of multiple facets that are dynamic and ever changing. There is no single rigid answer, but the best approach has been reached in the time awarded to set the baseline for future studies on this problematic.

Small pelagics are the dominant fisheries in Indonesia and the Philippines in terms of volume landings. In the Philippines this is the case for commercial and municipal fisheries, in INA this is not possible to assess since the statistics available do not discern between large and small-scale fisheries, but most probably it follows a similar trend than the Philippines.

Production levels of SPF have maintained a positively increasing overall trend since 1997, which is the base year of evaluation, indicating a constant supply that could satisfy the population's demand of animal protein. Still, it is important to note that capture per unit effort is in decline and fishing above the MSY is the reality for many SPF species and fishing grounds in both economies, indicating the small pelagics resources are in risk of an imminent collapse at any point if over fishing continues.

Nonetheless the prospects for sustainability are good in the Philippines. Tools for sustainable management of the small pelagics resources, such as fishing closures, have been initiated by the Philippines in 2011 for sardines, with the vision to extend it to other SPF species.

In Indonesia political will needs to be stronger and sources of alternative livelihood need to be identified for fishermen, in order to be bale to apply necessary management measures such as fishing closures for small pelagics in order to improve the sustainability prospects of the SPF resources.

Round scads (*Decapterus* spp) are the top species that should be regarded to tackle food security concerns. They are among the most productive species in INA and the RP. Other species that should be considered from INA are the short mackerel, goldstripe sardinella,

yellowstripe scads and Stolephorus anchovies, and from the RP the spotted sardinella and the frigate tuna, all of these species have volume landings of above 150, 000 MT per economy.

Small pelagics are also the preferred group of fish for consumption in INA and the RP, being round scads the overall preferred species, which coincidently is the species of higher production.

Even though production is high and increasing in Indonesia and the Philippines, their internal production fails to cover internal consumption demands due to the large size of their populations. Taste and preference for small pelagics are culturally printed in the population so economies with surplus production of SPF like Peru and Chile could aid to satisfy this demand through trade.

The greatest limitation for small pelagics to tackle food security in Asia-Pacific is posed by the dissected territories of INA and the RP, which are a huge challenge for distribution to the most isolated and vulnerable populations to food insecurity. Under this scenario, added-value products from small pelagics would be a perfect alternative; they would ease portability and reduce fish losses through distribution chains. However price issues are yet to be assessed as value-added are generally more expensive and these vulnerable populations are usually among the poorest sectors of society.

5. Lessons learned

5.1 Strategies and processes that led to success

To start coordinating the implementation of the project with partner economies, it worked to send a first contact e-mail to the focal point of each case study economy followed by a phone call to confirm reception and confirm that the person contacted was still responsible for supporting the project. This was learned after several e-mails that remained without response because they were sent to previous focal points who did not work in the public sector anymore or whose responsibilities had changed due to the high position rotation within the public sector.

The company of local staff from NFRDI and RCFMC during fieldwork was key to the successful completion of consumer surveys, for cultural issues and also because the support of staff from national agencies granted more seriousness and raised more interest from the people surveyed.

The involvement of the network of enumerators of NFRDI to support conducting surveys in the Philippines was a great asset that helped to widely surpass the targeted number of surveys.

5.2 Areas of potential improvement

The analyses of consumer surveys could be done in further detail and improved, data was collected for fishing and non-fishing communities but could not be analysed in more detail due to time constraints. This data that could reveal important findings regarding the uses of SPF by fishing communities, which are among the most vulnerable populations to food insecurity due to their strong dependence on SPF for their livelihoods.

The Bureau of Agriculture Statistics of the Philippines publishes the official national fisheries statistics in English and Filipino but with no reference to the referred scientific names of the species. The English names published are the common names used in the Philippines and are not standardised with the English nomenclature of the ASFIS used by FAO either, hence it is difficult and time consuming to learn the correct species to which each name corresponds and the data cannot be that easily interpreted. It is highly recommendable to add in the future fisheries statistics publications a section where both scientific names and English names according to the ASFIS can be referred.

Fisheries statistics of INA do not discern between small-scale fisheries and large-scale fisheries, landing volumes reported are all aggregated into a same category, so the contribution of each sector cannot be assesses like in the Philippines. In the Philippines, small-scale municipal fisheries contribute with a very significant proportion of marine fish production. Since small-scale fishermen have a stronger dependence on fishing activities for food security, it is deemed essential to keep track of small pelagics fisheries separately fro the two sectors.

6. Next steps

- Follow-up by the partner economies of Indonesia, Peru and the Philippine on the areas identified and discussed for the transfer of technology and knowledge to prepare new proposals to benefit the trade of small pelagic fish within the Asia-Pacific region.

7. References

Allen G.R., 2007 Conservation hotspots of biodiversity and endemism for Indo- Pacific coral reef fishes. *Aquatic Conservation: Marine and Freshwater Ecosystems* 18:541-556.

APEC, 2010. Paracas Declaration - *Healthy Oceans and Fisheries Management Towards Food Security*. Oceans-Related Ministerial Meeting. Paracas, Peru, 11 - 12 Oct 2010.

APEC, 2012a. Joint Statement, 2012 APEC Ministerial Meeting. Vladivostok, Russia, 5 - 6 Sep 2012. (www.m.apec.org/Meeting-Papers/Ministerial-Statements/Annual/2012/2012_amm.aspx)

APEC, 2012b. APEC Action Plan on Food Security. Asia-Pacific Information Platform on Food Security. (www.apip-apec.com/multi/plan/)

APEC, 2013. Asia-Pacific Economic Cooperation (WWW). (www.apec.org, January 2013)

Barut N.C., M.D. Santos, L.L. Mijares, R. Subade, N.B. Armada and L.R. Garces. 2003. Philippine coastal fisheries situation. P. 885-914 in *World Fish Center Conference Proceedings* 67, 1120 p.

BAS, 2002. Fisheries Statistics of the Philippines, 1997 – 2001. Report of the Fisheries Statistics Division of the Department of Agriculture, Bureau of Agricultural Statistics. Quezon City, Philippines.

BAS, 2004. Fisheries Statistics of the Philippines, 2001 – 2003. Report of the Fisheries Statistics Division of the Department of Agriculture, Bureau of Agricultural Statistics. Volume 12. Quezon City, Philippines.

BAS, 2007. Fisheries Statistics of the Philippines, 2004 – 2006. Report of the Fisheries Statistics Division of the Department of Agriculture, Bureau of Agricultural Statistics. Volume 15, Quezon City, Philippines.

BAS, 2008. Fisheries Statistics of the Philippines, 2005 – 2007. Report of the Fisheries Statistics Division of the Department of Agriculture, Bureau of Agricultural Statistics. Volume 16. Quezon City, Philippines.

BAS, 2010. Fisheries Statistics of the Philippines, 2007 – 2009. Report of the Fisheries Statistics Division of the Department of Agriculture, Bureau of Agricultural Statistics. Volume 18. Quezon City, Philippines.

BAS, 2011. Fisheries Statistics of the Philippines, 2008 – 2010. Report of the Fisheries Statistics Division of the Department of Agriculture, Bureau of Agricultural Statistics. Volume 19. Quezon City, Philippines.

BFAR, 2012. Bureau of Fisheries and Aquatic Resources (WWW)(www.bfar.da.gov.ph , October 2012)

Campos, W.L. and E.P. Moreno, 1991. Status of the small pelagic fisheries on the Philippines. Publication of the Philippine Council for Aquaculture and Marine Research and Development. PRIMER, Nº9.

Chávez, F.P., Ryan, J., Lluch Cota, S.E., and M. Ñiquen C. 2003. From anchovies to sardines and back. *Science:* 299, 217.

Carpenter K.E., V.G. Springer, 2004. The center of the center of marine shore fish biodiversity: the Philippine Islands. *Environmental Biology of Fish* 72: 467-480.

Dalzell P., P. Corpuz, F. Arce, R. Ganaden, 1990. Philippine small pelagic fisheries and their management. *Aquaculture and Fisheries Management* 21: 77-94.

FAO, 1999. Report of a Workshop on the Fishery and the Management of Bali Sardinella (Sardinella lemuru) in Bali Strait. Denpasar, Bali, Indonesia 6 – 8 April 1999. Workshop Proceedings and Recommendations. Fishcode Management FAO/Norway Programme of Assistance to Developing Countries for the Implementation of the Code of Conduct for Responsible Fisheries. Food and Agriculture Organization of the United Nations. Rome, September. 1999.

Merta, I.G.S, K. Widanas, Yunizal and R. Basuki, 2000. Status of The Lemuru Fishery in Bali Strait, Its Development and Prospects. A Paper Presented at The Workshop on the Fishery and Management of Bali Sardinell (Sardinella lemuru) in Bali Strait. Denpasar, Bali, Indonesia, 6-8 April 1999. Food and Agriculture Organization of the United Nations. Rome, June 2000.

FAO, 2011. Fisheries and Aquaculture Department, Statistics and Information Service FishStatJ: Universal software for fishery statistical time series. Copyright 2011

FAO. 2012a. The State of World Fisheries and Aquaculture 2012. Rome. 209 pp.

FAO, WFP and IFAD. 2012. The State of Food Insecurity in the World 2012. Economic growth is necessary but not sufficient to accelerate reduction of hunger and malnutrition. Rome, FAO.

Green, S.J., A.T. White, J.O. Flores, M.E. Carreon III and A. E. Sia, 2003. Philippine fisheries in crisis: A framework for management. Coastal resource Management Project of the Department of Environment and Natural Resources, Cebu City, Philippines, 77p.

Guanco M.R., S.V. Mesa, P.B. Belga and D.R.M. Nunal, 2009. Assessment of the commercial fisheries of Western and Central Visayan Sea. BFAR NFRDI Technical Paper Series 12: (1) 1-44.

Kurien, J. 2005. Responsible fish trade and food security. FAO Fisheries Technical Paper No. 456. Rome, FAO. 102pp.

Lymer, D., Funge-Smith, S., Clausen, J., and W. Miao, 2008. Status and potential of fisheries and aquaculture in Asia and the Pacific 2008. RAP PUBLICATION 2008/15. Bangkok, FAO. 90pp.

MMAF, 2008. Capture Fisheries Statistics of Indonesia, 2007. Report of the Directorate General of Capture Fisheries, Ministry of Marine Affairs and Fisheries.

MMAF, 2009. Capture Fisheries Statistics of Indonesia, 2008. Report of the Directorate General of Capture Fisheries, Ministry of Marine Affairs and Fisheries.

MMAF, 2010. Capture Fisheries Statistics of Indonesia, 2009. Report of the Directorate General of Capture Fisheries, Ministry of Marine Affairs and Fisheries.

MMAF, 2011. Capture Fisheries Statistics of Indonesia, 2010. Report of the Directorate General of Capture Fisheries, Ministry of Marine Affairs and Fisheries.

MMAF, 2012. Ministry of Marine Affair and Fisheries. (WWW)(www.kkp.go.id , October 2012)

NCFSA, 2011. Map of the National Commission of Fish Stock Assessment 'Exploitation Status of Marine Fish Resources in Indonesian Fisheries Management Areas (Dec 2010)'. *In*: Suwarso, 2012. 'Introduction to the fisheries management in Indonesia'. Presentation at the APEC Meeting of Project FWG01 2010A, 'Potential Contribution of Small Pelagic Fish to Food Security within the Asia-Pacific Region', Lima, Peru, 22th October 2012.

Pauly D., Silvestre G.T., Smith I.R., 1989. On development, fisheries and dynamite: a brief review of tropical fisheries management. *Nat. Resour. Modelling:* 3(3): 307-329

Pagdilao, C.R., Corpuz, M.A.L.C., and E. Moreno. 1993. Status of the small pelagics fisheries industry. Publication of the Philippine Council for Aquaculture and Marine Research and Development. PRIMER, Nº21.

Potier, M. and S. Nurhakim, 1995. (eds). BIODYNEX: Biology, dynamics, exploitation of the small pelagic fishes in the Java Sea, Pelfish Jakarta, 281p.

PRODUCE, 2012. Ministerio de la Producción. (WWW)(www.produce.org.pe , October 2012)

Ramos M.H., M.B. Candelario, E.M. Mendoza, and F. Lavapie-Gonzales, 2009. The Honda Bay fisheries: An assessment. BFAR NFRDI Technical Paper Series 12: (2) 1-45.

Schwartzlose R.A., J. Alheit, A. Bakun, T.R. Baumgartner, R. Cloete, R.JM. Crawford, W.J. Fletcher, Y. Green-Ruiz, E. Hagen, T. Kawasaki, D. Lluch-Belda, S.E. Lluch-Cota, A.D. MacCall, Y Matsuura, M.O. Nevarez-Martinez, R.H. Parrish, C. Roy, R. Serra, K.V. Shust, M.N. Ward and J.Z.

Zuzunaga, 1999. Worldwide large-scale fluctuations of sardine and anchovy populations. *South African Journal of Marine Science*. 21: 289-347.

Suwarso, 2012. Introduction to the Fisheries Management in Indonesia. Presentation of the meeting held in Lima as part of APEC: Project FWG01 2010A, Potential Contribution of Small Pelagic Fish to Food Security within the Asia-Pacific Region, Lima, 22th October 2012.

Thilsted, S. & Roos, N. 1999. Policy issues on fisheries in relation to food and nutrition security. In M. Ahmed, C. Delgado, S. Sverdrup-Jensen & R. Santos, eds. Fisheries policy research in developing countries: issues, priorities and needs, pp. 61-69. Makati City, Philippines, International Center for Living Aquatic Resources Management.

Whitehead, P.J.P., 1985. FAO species catalogue Vol 7. Clupeoid fishes of the world: An annotated and illustrated catalogue of the herrings, sardines, pilchards, sprats, shads, anchovies and wolf-herrings. Part 1 – Chirocentridae, Clupeidae and Pristigasteridae. FAO Fisheries Synopsis (125) 7 pp 303.

Willette, D.A, Bognot, E.D.C, Mutia, M.T.M and M.D. Santos. Biology and Ecology of sardines in the Philippines. Technical Paper Series, Vol. 13, Nº 1.